Plant Assessment Form

For use with the "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" by the California Exotic Pest Plant Council and the Southwest Vegetation Management Association (Warner et al. 2003)

Printable version, February 28, 2003
(Modified for use in Arizona, 07/02/04)

Table 1. Species and Evaluator Information

Species name (Latin binomial)**:**	*Cardaria chalapensis* (L.) Hand.-Maz.; *Cardaria draba* (L.) Desv.; *Cardaria pubescens* (C.A. Mey.) Jarmolenko (USDA 2005)
Synonyms:	*Cardaria chalapensis:* *Cardaria draba* (L.) Desv. ssp. *chalapensis* (L.) O.E. Schulz, *Cardaria draba* (L.) Desv. var. *repens* (Schrenk) O.E. Schulz, *Cardaria repens* (Schrenk) Jarmolenko, *Lepidium repens* (Schrenk) Boiss.; *Cardaria draba:* *Lepidium draba* L.; *Cardaria pubescens*: *Cardaria pubescens* (C.A. Mey.) Jarmolenko var. *elongata* Rollins and *Hymenophysa pubescens* C.A. Mey. (USDA 2005)
Common names:	*Cardaria pubescens*: lenspod whitetop, lens podded hoary cress *Cardaria draba:* whitetop, globe-podded hoary cress *Cardaria pubescens*: hairy whitetop
Evaluation date (mm/dd/yy)**:**	08/11/03
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Committee review date:	10/23/03, 12/17/03, and 02/17/04
List date:	12/17/03; revised 02/17/04
Re-evaluation date(s):	

Taxonomic Comment

A 1933 study by Bellue showed that *Cardaria draba*, known to North America, consisted of three European and Asian species: *C. chalapensis*, *C. draba, and C. pubescens* (Lyons, 1998). Although at times one or more of the preceding have been treated as subspecies, we follow the treatment of USDA (2005) that treats each taxon as a separate species. Based on herbarium records and personal communications with A. Salywon (Research Geneticist, U.S. Department of Agriculture, Agricultural Research Service, Water Conservation Laboratory, Phoenix, Arizona, 2005) all three taxa were determined to occur within Arizona wildlands. *Cardaria chalapensis, C. draba, and C. pubescens* are evaluated together here as they are genetically and morphologically similar, as well as have comparable ranges and habitat affinities (Bossard and Chipping 2000, Baldwin et al. 2002). In addition, because of the similar appearance of these three species they are easily misidentified in the field, as they require fruit to be properly identified (taxonomic differentiation between *C. draba and C. chalapensis* is in the shape of fruit; *C. pubescens* is differentiated by hairy fruit).

Recent unpublished work by A. Salywon (Research Geneticist, U.S. Department of Agriculture, Agricultural Research Service, Water Conservation Laboratory, Phoenix, Arizona, personal communication, 2005) suggests that the above taxa should be placed in the genus *Lepidium*, in which *Cardaria chalapensis* equals *Lepidium draba* ssp. *chalapense*, *Cardaria draba* equals *Lepidium draba* ssp. *draba*, and *Cardaria pubescens* equals *Lepidium appelianum* Al-Shehbaz. Until this work has been appropriately reviewed and published we have chosen to stay with the taxonomic treatment of USDA (2005).

Table 2. Scores, Designations, and Documentation Levels

Question		Score	Documentation Level	Section Scores	Overall Score & Designations
1.1	Impact on abiotic ecosystem processes	**B**	Other published material	**"Impact"** **Section 1 Score:** **B**	**"Plant Score"** **Overall Score:** **Medium** **Alert Status:** **Alert**
1.2	Impact on plant community	**A**	Other published material		
1.3	Impact on higher trophic levels	**B**	Other published material		
1.4	Impact on genetic integrity	**D**	Other published material		
2.1	Role of anthropogenic and natural disturbance	**B**	Other published material	**"Invasiveness"** *For questions at left, an A gets 3 points, a B gets 2, a C gets 1, and a D or U gets=0. Sum total of all points for Q2.1-2.7:* **14 pts** **Section 2 Score:** **B**	
2.2	Local rate of spread with no management	**B**	Observational		
2.3	Recent trend in total area infested within state	**C**	Observational		
2.4	Innate reproductive potential	**A**	Other published material		
2.5	Potential for human-caused dispersal	**A**	Other published material		
2.6	Potential for natural long-distance dispersal	**B**	Reviewed scientific publication		
2.7	Other regions invaded	**C**	Other published material		RED FLAG **NO** Something you should know.
3.1	Ecological amplitude	**B**	Observational	**"Distribution"** **Section 3 Score:** **C**	
3.2	Distribution	**D**	Observational		

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes *Score:* **B** *Doc'n Level:* **Other pub.**
Identify ecosystem processes impacted: Reduction of soil water table, and light availability diminish ability of native species to reproduce.
Rationale: All species of *Cardaria* have extensive systems of persistent, deep, vertical and horizontal roots that penetrate the soil to depths of 2 m or more (CDFA 2003). All three *Cardaria* species are strong competitors for moisture, which puts native communities at a disadvantage (Bossard and Chipping 2000).
Sources of information: See cited literature.

Question 1.2 Impact on plant community composition, structure, and interactions *Score:* **A** *Doc'n Level:* **Other pub.**
Identify type of impact or alteration: *Cardaria draba* forms dense patches and reduces native species populations.
Rationale: *Cardaria draba* establishes monospecific mats that exclude most vegetation. *Cardaria chalapensis* forms dense infestations in meadows and fields that outcompete forage plants for wildlife in California (Bossard and Chipping 2000). At Nature Conservancy preserves in Northern Idaho and at the Yampa River in Colorado, *C. draba* is reported as a moderate threat to biodiversity and infestations are currently 1% of all vulnerable habitat infested (Hill 1995, Williams 1995). Mycorrhizal associations do not develop with any of the three species of *Cardaria*, which may alter the trophic relationships in the soil (Lyons 1998) Patches in Yavapai County create a monoculture where occlusion of native species is likely (J. Schalau, personal communication, 2003). On Audubon Appleton-Whittell Research Ranch (ARR), *C. draba* was found in the spring of 2000, in a disturbed area at the intersection of a road and wash through a sacaton grassland. L. Kennedy reports from monitoring the population, that there is no indication that the *C. draba* displaced any native vegetation, but it seems likely that it could, over time. Of similar habitat on ARR, *C. draba* currently covers less than 1% (L. Kennedy, personal communication, 2003).
Sources of information: See cited literature; also considered personal communications with J. Schalau (Assistant Agent, Agriculture and Natural Resources, University of Arizona Cooperative Extension, Yavapai County, 2003) and L. Kennedy (Assistant Director, Audubon Appleton-Whittell Research Ranch, Elgin, Arizona, 2003). In addition, see Sheley and Stivers (2000).

Question 1.3 Impact on higher trophic levels *Score:* **B** *Doc'n Level:* **Other pub.**
Identify type of impact or alteration: Moderate reduction in foraging sites for native animals. *Cardaria chalapensis* is toxic to stock-unknown if toxic to foraging ungulates. Positive impact-plants provide nectar for honeybees (Sheley and Stivers 2000).
Rationale: *Cardaria draba* displaces valuable rangeland forage species (Lyons 1998), and *C.chalapensis* forms dense infestations that crowd out forage plants in meadows and fields. By displacing native vegetation utilized by wildlife, both species demonstrate the ability to impact native fauna negatively (Bossard and Chipping 2000). *Cardaria chalapensis* contains glucosnolates, which are toxic to stock and could have the same reaction to native ungulates (Sheley and Stivers 2000).
Sources of information: See cited literature.

Question 1.4 Impact on genetic integrity *Score:* **D** *Doc'n Level:* **Other pub.**
Identify impacts: No known hybridization between native plants of same genus.
Rationale: No known native species of *Cardaria* exists in the state. (Kearney and Peebles 1960). Plants identified as *C. draba* var. *repens* are apparent hybrids with *C. chalapensis* (Baldwin et al. 2002). According to A. Salywon (personal communication, 2003), species of *Cardaria* have been shown using molecular data to belong in *Lepidium* (most *Cardaria* were originally described as species of *Lepidium*).

Apparently, however, no hybridization occurs between them and the native species of *Lepidium*, though hybridization between the native species of *Lepidium* is common.
Sources of information: See cited literature; also considered personal communication with A. Salywon, (Research Geneticist, U.S. Department of Agriculture, Agricultural Research Service, Water Conservation Laboratory, Phoenix, Arizona, 2003).

Question 2.1 Role of anthropogenic and natural disturbance in establishment *Score:* **B** *Doc'n Level:* **Other pub.**
Describe role of disturbance: Both species readily establish in disturbed areas in range and wildland areas.
Rationale: Cultivation in agricultural fields aids in dispersal as farm machinery can spread plants by dispersing root fragments. Invasion potential is greater under heavily grazed conditions or other disturbances. Irrigation causes increases in population (CDFA 2003). These species grow in a variety of habitats, but they thrive in disturbed or irrigated areas. They are less of a problem in undisturbed settings (Lyons 1998). The Nature Conservancy reports types of disturbance that promote colonization and spread on preserves in Colorado, Idaho and Montana including grazing (Carr 1995), irrigation, and cultivation (O'Brien and O'Brien 1994). In Las Vegas Wash in Nevada, natural disturbance creates new populations (T. Olson, personal communication, 2003)
Sources of information: See cited literature; also considered observations by T. Olson (Wildlife Biologist, Bureau of Reclamation, Boulder City, Nevada, 2003).

Question 2.2 Local rate of spread with no management *Score:* **B** *Doc'n Level:* **Obs.**
Describe rate of spread: Increases, but less rapidly.
Rationale: In Saskatchewan, Canada in one year, a single plant on open ground without competition can spread vegetatively to cover an area to 3.7 m in diameter and can produce up to 455 shoots (CDFA 2003). Also, infestations of both species contracted when in competition with other species (particularly perennials) and when not irrigated. In Grand Canyon National Park, two populations totaling 280 m^2 have increased slightly, even with management (Rodeo herbicide application) (L. Johnson, personal communication, 2003). Prescott populations are small and isolated monocultures. In Camp Verde the populations are on agricultural land and cultural practices may be increasing their spread (J. Schalau, personal communication, 2003). At Audubon Appleton-Whittell Research Ranch plants were treated early in the spring (2001). The next year, 2002, the infestation had spread at least 1/4 mile downstream in the wash and in the open spaces between the sacaton near the wash, apparently from seed (L. Kennedy, personal communication, 2003).
Sources of information: See cited literature; also considered personal communications with L. Johnson (Ecologist, U.S. Department of Agriculture, Forest Service, Kaibab National Forest, 2003), L. Kennedy (Assistant Director, Audubon Appleton-Whittell Research Ranch, Elgin, Arizona, 2003), and J. Schalau (Assistant Agent, Agriculture and Natural Resources, University of Arizona Cooperative Extension, Yavapai County, 2003) and Southwest Exotic Plant Management Program (SWEMP) records for Grand Canyon National Park 2001 to 2003 (available online at: http://www.usgs.nau.edu/swepic/swemp/maps.html).

Question 2.3 Recent trend in total area infested within state *Score:* **C** *Doc'n Level:* **Obs.**
Describe trend: Stable.
Rationale: CAIN/CRISIS Map records three occurrences of *C. draba*: one in Yavapai, one in Coconino, and one in Mohave County. Parker (1972) reported *C. draba* on ranches in the Springerville-Eager area in Apache County to Peeples Valley in Yavapai County and northward to Fredonia in Coconino County. Populations at Grand Canyon National Park remained relatively stable with Rodeo herbicide treatment. Cultural practices may be increasing populations somewhat in Yavapai County (J. Schalau, personal

communication, 2003). In 1972 *C. pubescens* was unknown in Arizona (Parker 1972). Its current distribution in the state seems quite limited (A. Salywon, personal communication, 2003). *Cardaria chalapensis* is distributed in southern and central counties of UT, but similar to *C. pubescens* seems to have limited distribution in Arizona (A. Salywon, personal communication, 2003).

Sources of information: See cited literature; also considered CAIN/CRISIS Map (available online at: http://cain.nbii.gov/cgibin/mapserv?map=../html/cain/crisis/crisismaps/crisis.map&mode=browse&layer=state&layer=county), Southwest Exotic Plant Management Program (SWEMP) records for Grand Canyon National Park 2001 to 2003 (available online at: http://www.usgs.nau.edu/swepic/swemp/maps.html), and personal communications from A. Salywon (Research Geneticist, U.S. Department of Agriculture, Agricultural Research Service, Water Conservation Laboratory, Phoenix, Arizona, 2005) and J. Schalau (Assistant Agent, Agriculture and Natural Resources, University of Arizona Cooperative Extension, Yavapai County, 2003).

Question 2.4 Innate reproductive potential *Score:* **A** *Doc'n Level:* **Other pub.**

Describe key reproductive characteristics: Plants reproduce from seeds and underground rhizome/root fragments.

Rationale: *Cardaria draba* plants can produce 1,500 to 4,800 seeds in a year with 85% viability and can produce 455 shoots. *Cardaria pubescens* plants produce 30 to 560 (average 300) pods per plant.

Sources of information: See CDFA (2003).

Question 2.5 Potential for human-caused dispersal *Score:* **A** *Doc'n Level:* **Other pub.**

Identify dispersal mechanisms: Seeds are dispersed by water, vehicles, farm machinery, and contaminated hay and crop seeds. Grazing activities can cause *C. draba* populations to invade an area.

Rationale: *Cardaria* spp. are agricultural weeds that can be transported via humans, as root fragments transported by farm machinery can potentially reestablish in new areas (CDFA 2003). *Cardaria draba* population germination rates were greatest in areas of soil disturbance (Larson et al. 2000)

Sources of information: See cited literature.

Question 2.6 Potential for natural long-distance dispersal *Score:* **B** *Doc'n Level:* **Rev. sci. pub.**

Identify dispersal mechanisms: Dispersal of root fragments through flooding events.

Rationale: *Cardaria* spp. reproduce vegetatively from rhizomatous systems and less importantly by seed (Lyons 1998). Severed root segments only 1.3 cm long can regenerate into new plants if they are left within approximately 7 to 10 cm or the soil surface (Scurfield 1962). All three species are found to be a problem in moist environments, including drainage ditches like Las Vegas Wash, where the potential for long-distance dispersal via flooding events is possible (T. Olson, personal communication, 2003). In Camp Verde, populations are on agricultural lands and cultural practices may be increasing their spread. These lands are also adjacent to the Verde River adding to the potential for increased spread (J. Schalau, personal communication, 2003). On Audubon Appleton-Whittell Research Ranch, *C. draba* was found in the spring of 2000, in a disturbed area at the intersection of a road and wash through a sacaton grassland. Total area of coverage was approximately 20 m x 40 m. It's likely that seed or rhizomes were introduced via gravel used to surface the road. The entire spread of *C. draba* is downstream of this point (L. Kennedy, personal communication, 2003). The dispersal that L. Kennedy reports at the Audubon Appleton-Whittell Research Ranch is due to seeds in addition to root fragments, but this is based on the observation that the spread is within the arroyo (wash) where root fragments are likely to be created and carried, but also on the floodplain terrace where overland flow is less dramatic and root fragmentation is less likely. This dispersal mechanism could potentially be a severe problem if there were two wet winters in a row. The first to produce a good crop of seed and the second to allow the seed to germinate and establish (L. Kennedy, personal communication, 2003).

Sources of information: See cited literature; also considered observations by L. Kennedy (Assistant Director, Audubon Appleton-Whittell Research Ranch, Elgin, Arizona, 2003), T. Olson (Wildlife

Biologist, Bureau of Reclamation, Boulder City, Nevada, 2003), and J. Schalau (Assistant Agent, Agriculture and Natural Resources, University of Arizona Cooperative Extension, Yavapai County, 2003).

Question 2.7 Other regions invaded	*Score:* **C** *Doc'n Level:* **Other pub.**
Identify other regions: Invades elsewhere but only in ecological types that it has already invaded in the state.	
Rationale: In California *C. draba* is frequent in Sacramento Valley, San Francisco Bay, and South Coast regions to 3850 feet. *Cardaria pubescens* is frequent in the Sacramento Valley, South Coast region, and Great Basin to 6560 feet. In Wyoming *C. draba* invades riparian meadows (Studenmund 1995). In Colorado at the Yampa River Preserve, *C. draba* invades open grasslands of non-native species (Williams 1995). In Idaho it is reported from willow/rose riparian edge. In Utah *C. draba* has a distribution throughout the central northwestern part of the state with an elevation range from 1,330 to 2,670 meters.	
Sources of information: See cited literature; also see O'Brien and O'Brien (1994), Hill (1995), CDFA (2003), and the Vascular Plant Atlas of Utah (available online at: http://www.gis.usu.edu/Geography-Department/utgeog/utvatlas, September 2003).	

Question 3.1 Ecological amplitude	*Score:* **B** *Doc'n Level:* **Obs.**
Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: Introduced from central Europe and western Asia, specifically Georgia, Syria, Iraq, Iran, and Armenia. Introduction date to Arizona is unknown. Present in three Arizona ecological types.	
Rationale: *Cardaria draba* is found in the west from Colorado to Wyoming to California and also on the east coast. First collected in 1876. *Cardaria pubescens* probably arrived from infested alfalfa seed from Turkestan and was first collected in North America in 1919. This species is more common in the northwestern USA with few occurrences in the mid-west. Ecological types invaded may indicate distribution is limited by excessive temperatures and adequate moisture.	
Sources of information: See Lyons (1998) and Bossard and Chipping (2000); also applied inference.	

Question 3.2 Distribution	*Score:* **D** *Doc'n Level:* **Obs.**
Describe distribution: Present in three Arizona ecological types but less than or equal to 5% occurrence in each.	
Rationale: Observations of *C. draba* collectively reported by Working Group members in grasslands, montane forest, and southwestern interior riparian based on observations in Grand Canyon ponderosa pine, Las Vegas Wash, and Petrified National Forest communities.	
Sources of information: Observations by T. Olson (Wildlife Biologist. Bureau of Reclamation. Boulder City, Nevada, 2003), L. Makarick (Below the Rim Vegetation Program Manager, Grand Canyon National Park Science Center, Flagstaff, Arizona, 2003), and K. Thomas (Vegetation Ecologist, U.S. Geological Survey, Southwest Biological Science Center, Flagstaff, Arizona, 2003).	

Worksheet A. Reproductive Characteristics

Complete this worksheet to answer Question 2.4.

Reaches reproductive maturity in 2 years or less	**Yes**	**No**	**1 pt.**
Dense infestations produce >1,000 viable seed per square meter	**Yes**	**No**	**2 pt.**
Populations of this species produce seeds every year.	**Yes**	**No**	**1 pt.**
Seed production sustained for 3 or more months within a population annually	**Yes**	**No**	**1 pt.**
Seeds remain viable in soil for three or more years	**Yes**	**No**	**2 pt.**
Viable seed produced with *both* self-pollination and cross-pollination	**Yes**	**No**	**1 pt.**
Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes	**Yes**	**No**	**1 pt.**
Fragments easily and fragments can become established elsewhere	**Yes**	**No**	**2 pt.**
Resprouts readily when cut, grazed, or burned	**Yes**	**No**	**1 pt.**

Total pts: 9 Total unknowns: 0

Score : A

Note any related traits:

Worksheet B. Arizona Ecological Types

(*sensu* Brown 1994 and Brown et al. 1998)

Major Ecological Types	Minor Ecological Types	Code*
Dunes	dunes	
Scrublands	Great Basin montane scrub	
	southwestern interior chaparral scrub	
Desertlands	Great Basin desertscrub	
	Mohave desertscrub	
	Chihuahuan desertscrub	
	Sonoran desertscrub	
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	
	semi-desert grassland	**D**
Freshwater Systems	lakes, ponds, reservoirs	
	rivers, streams	
Non-Riparian Wetlands	Sonoran wetlands	
	southwestern interior wetlands	
	montane wetlands	
	playas	
Riparian	Sonoran riparian	
	southwestern interior riparian	**D**
	montane riparian	
Woodlands	Great Basin conifer woodland	
	Madrean evergreen woodland	
Forests	Rocky Mountain and Great Basin subalpine conifer forest	
	montane conifer forest	**D**
Tundra (alpine)	tundra (alpine)	

*A means >50% of type occurrences are invaded; B means >20% to 50%; C means >5% to 20%; D means present but ≤5%; U means unknown (unable to estimate percentage of occurrences invaded).

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